Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

Claim 1. (previously presented) A method for detecting a crater end of a continuously cast product, the method comprising the steps of

installing an ultrasonic shear wave sensor for transmitting an ultrasonic shear wave to the continuously cast product and receiving the transmitted ultrasonic shear wave and an ultrasonic longitudinal wave sensor for transmitting an ultrasonic longitudinal wave to the continuously cast product and receiving the transmitted ultrasonic longitudinal wave at the same position in a continuous casting machine or at positions apart from each other in a casting direction, but at the same position in a transverse direction of the cast product,

detecting based on variations of an ultrasonic signal received by the ultrasonic shear wave sensor that the crater end

of the cast product is matched with an installed position of the ultrasonic shear wave sensor,

calibrating a calculation formula for determining the crater end from a propagation time of an ultrasonic longitudinal wave signal such that the crater end computed from the propagation time of the ultrasonic longitudinal wave signal at that time is matched with the installed position of the ultrasonic shear wave sensor, and after the calibration,

determining the crater end from the propagation time of the ultrasonic longitudinal wave signal based on the calibrated calculation formula.

Claim 2. (original) The method for detecting a crater end of a continuously cast product according to Claim 1, further comprising the steps of installing a second ultrasonic shear wave sensor downstream of said ultrasonic shear wave sensor in the casting direction at the same position in the transverse direction of the cast product, detecting based on variations of an ultrasonic signal received by the second ultrasonic shear wave sensor that the crater end of the cast product is matched with

the installed position of the second ultrasonic shear wave sensor, and further calibrating the calculation formula for determining the crater end from the propagation time of the ultrasonic longitudinal wave signal such that the crater end computed from the propagation time of the ultrasonic longitudinal wave signal at that time is matched with the installed position of the second ultrasonic shear wave sensor.

Claim 3. (original) The method for detecting a crater end of a continuously cast product according to Claim 1 or 2, wherein the calculation formula for determining the crater end from the propagation time of the ultrasonic longitudinal wave signal differs between when the crater end is positioned upstream of the installed position of the ultrasonic longitudinal wave sensor in the casting direction and when the crater end is positioned downstream thereof.

Claims 4 to 6. (canceled)

Claim 7. (previously presented) A method for detecting a crater end of a continuously cast product, the method comprising the step of, from a propagation time of an ultrasonic longitudinal wave signal measured by an ultrasonic longitudinal wave sensor installed in the continuous casting machine for which the calibration has been made or in a different continuous casting machine, determining the crater end in the continuous casting machine that the ultrasonic longitudinal wave sensor is installed by using the calculation formula calibrated by the method according to Claim 1 or Claim 2.

Claims 8 to 9. (canceled)

Claim 10. (previously presented) A method for detecting a crater end of a continuously cast product, the method comprising the steps of determining the crater end of the cast product by the method for detecting a crater end of a continuously cast product according to Claim 1 or Claim 2, and adjusting a casting speed or intensity of secondary cooling for the cast product in accordance with the determination result.

Claim 11. (previously presented) An apparatus for detecting a crater end of a continuously cast product, the apparatus comprising

an ultrasonic shear wave sensor made up of an ultrasonic shear wave transmitter for transmitting an ultrasonic shear wave to the continuously cast product and an ultrasonic shear wave receiver for receiving the transmitted ultrasonic shear wave,

an ultrasonic longitudinal wave sensor made up of an ultrasonic longitudinal wave transmitter for transmitting an ultrasonic longitudinal wave to the continuously cast product and an ultrasonic longitudinal wave receiver for receiving the transmitted ultrasonic longitudinal wave, the ultrasonic longitudinal wave sensor being installed at the same position in a continuous casting machine as the ultrasonic shear wave sensor or a position apart from the ultrasonic shear wave sensor in a casting direction but at the same position in a transverse direction of the cast product, and

a crater end computing unit for determining the crater end of the cast product by using a calculation formula in accordance with an ultrasonic signal received by the ultrasonic longitudinal

wave sensor and for calibrating the calculation formula, at the time when it is confirmed based on variations of an ultrasonic signal received by the ultrasonic shear wave sensor that an installed position of the ultrasonic shear wave sensor and the crater end of the cast product are matched with each other, such that the crater end computed based on the calculation formula is matched with the installed position of the ultrasonic shear wave sensor.

Claim 12. (previously presented) The apparatus for detecting a crater end of a continuously cast product according to Claim 11, further comprising a second ultrasonic shear wave sensor installed downstream of said ultrasonic shear wave sensor in the casting direction at the same position in the transverse direction of the cast product, wherein the crater end computing unit further calibrates the calculation formula, at the time when it is confirmed based on variations of an ultrasonic signal received by the second ultrasonic shear wave sensor that the installed position of the second ultrasonic shear wave sensor and the crater end of the cast product are matched with each other,

such that the crater end computed based on the calculation formula is matched with the installed position of the second ultrasonic shear wave sensor.

Claim 13. (original) The apparatus for detecting a crater end of a continuously cast product according to Claim 11 or 12, wherein the ultrasonic shear wave transmitter and the ultrasonic longitudinal wave transmitter are installed on one side of the cast product, the ultrasonic shear wave receiver and the ultrasonic longitudinal wave receiver are installed on the other side of the cast product, and a set of the ultrasonic shear wave transmitter and the ultrasonic longitudinal wave transmitter and a set of the ultrasonic shear wave receiver and the ultrasonic longitudinal wave receiver are each constituted as an integral electromagnetic ultrasonic sensor having three or more magnetic poles in the transverse direction of the cast product and made up of a longitudinal wave coil arranged to wind the surrounding of an inner magnetic pole aside from a surface thereof and a shear wave coil arranged to overlie the magnetic pole surface.

Claims 14 to 16. (canceled)

Claim 17. (previously presented) A method for detecting a crater end of a continuously cast product, the method comprising the step of, from a propagation time of an ultrasonic longitudinal wave signal measured by an ultrasonic longitudinal wave sensor installed in the continuous casting machine for which the calibration has been made or in a different continuous casting machine, determining the crater end in the continuous casting machine that the ultrasonic longitudinal wave sensor is installed by using the calculation formula calibrated by the method according to Claim 3.

Claim 18. (previously presented) A method for detecting a crater end of a continuously cast product, the method comprising the steps of determining the crater end of the cast product by the method for detecting a crater end of a continuously cast product according to Claim 3, and adjusting a casting speed or intensity of secondary cooling for the cast product in accordance with the determination result.

Claims 19 to 21. (canceled)

Claim 22. (previously presented) The apparatus for detecting a crater end of a continuously cast product according to Claim 11, further comprising a crater end arrival detecting unit for detecting, based on variations of an ultrasonic signal received by the ultrasonic shear wave sensor, that the crater end of the cast product is matched with the installed position of the ultrasonic shear wave sensor, and sending a signal to the crater end computing unit.

Claim 23. (previously presented) The apparatus for detecting a crater end of a continuously cast product according to Claim 11, further comprising a longitudinal-wave propagation time detecting unit for detecting a propagation time of an ultrasonic longitudinal wave signal in accordance with an ultrasonic signal received by the ultrasonic longitudinal wave sensor, and wherein the crater end computing unit uses the calculation formula that determines the crater end from the longitudinal-wave

propagation time detected by the longitudinal-wave propagation time detecting unit.

Claim 24. (previously presented) The apparatus for detecting a crater end of a continuously cast product according to Claim 12, further comprising a second crater end arrival detecting unit for detecting, based on variations of an ultrasonic signal received by the second ultrasonic shear wave sensor, that the crater end of the cast product is matched with the installed position of the second ultrasonic shear wave sensor and sending a signal to the crater end computing unit.